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Technical Notes

Unilateral laminotomy for bilateral decompression and balloon kyphoplasty to decompress lumber canal stenosis aggravated by osteoporotic vertebral compression fractures: A technical note

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ABSTRACT

Background: The optimal treatment of lumbar canal stenosis (LCS) associated with osteoporotic vertebral fractures (OVFs) remains unclear. Here, we have combined a minimally invasive unilateral laminotomy for bilateral decompression (ULBD) alone with balloon kyphoplasty (BKP) for LCS aggravated by OVF.

Methods: ULBD with BKP was performed in three patients who showed LCS associated with OVFs on MR images with progressive lower extremity neurological deficits. Clinical outcomes were assessed using the numerical rating scale (NRS) and the Japanese Orthopaedic Association (JOA) score. Radiological outcomes were evaluated using multiple parameters (i.e., fractured vertebral body height, lumbar lordosis [LL], and focal angle of the fractured vertebral body).

Results: Over 6 postoperative months, the NRS and JOA scores were clearly improved while radiological parameters remained maintained (i.e., loss of fractured vertebral body height was only 0.3–1.4 mm in all cases). Two of the three cases showed restoration of LL and focal angle postoperatively.

Conclusion: The combination of ULBD with BKP is an effective option for LCS aggravated by OVF.

Keywords: Balloon kyphoplasty, Lumbar canal stenosis, Minimally invasive surgery, Osteoporotic vertebral fracture, Percutaneous cement augmentation

INTRODUCTION

Here, we present a novel minimally invasive surgical technique, consisting of unilateral laminotomy for bilateral decompression (ULBD) combined with balloon kyphoplasty (BKP) for

Table 1: Surgical outcomes.

					Clinical assessment						Radiological assessment					
					Preoperative			6 months after surgery			Preoperative			6 months after surgery		
No.	Age	Sex	BKP level	Decompression level	JOA score†	Low back pain*	Leg pain*	JOA score†	Low back pain*	Leg pain*	Vertebral body height	LL	Focal angle	Vertebral body height	LL	Focal angle
1	83	M	L5	L3-S1	19	5	4	23	1	2	28.8	31.5	−2.5	28.5	31.6	−0.1
2	88	F	L4	L3/4	20	3	8	25	2	0	16.8	25.6	−5.7	16.70	30	−3.0
3	84	F	L4	L3/4	17	7	7	24	2	1	22.6	51	9.7	21.2	45	9.1

BKP: ballon kyphoplasty, JOA: Japanese Orthopaedic Association, LL: Lumbar lodosis, †JOA score; ranging from 0 to 29, with lower scores suggestive of more severe deficits.
*A numerical rating scale (NRS) was used to assess the intensity of the patient's pain on a scale of 0 to 10, with zero representing "no pain at all" and 10 representing "worst pain ever.

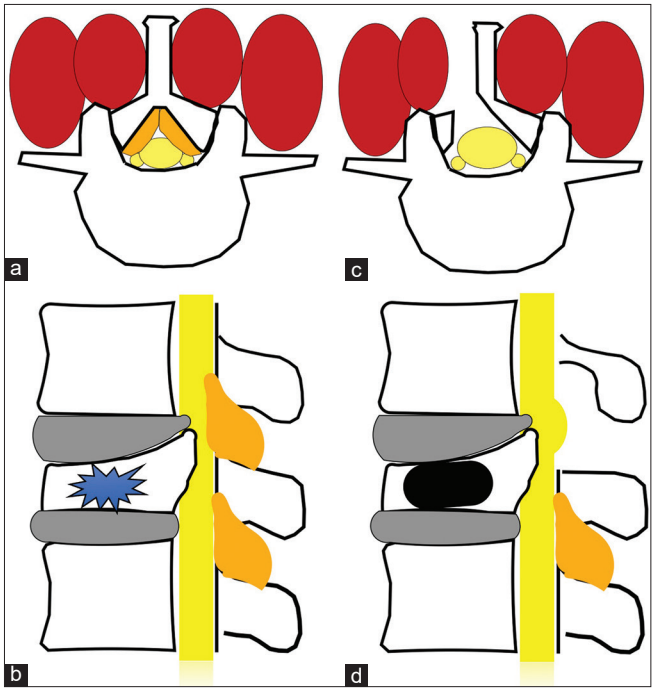

Figure 1: Illustration of lumbar canal stenosis aggravated by osteoporotic vertebral fracture and unilateral laminotomy for bilateral decompression combined with balloon kyphoplasty. (a and b) Axial and (c and d) sagittal.

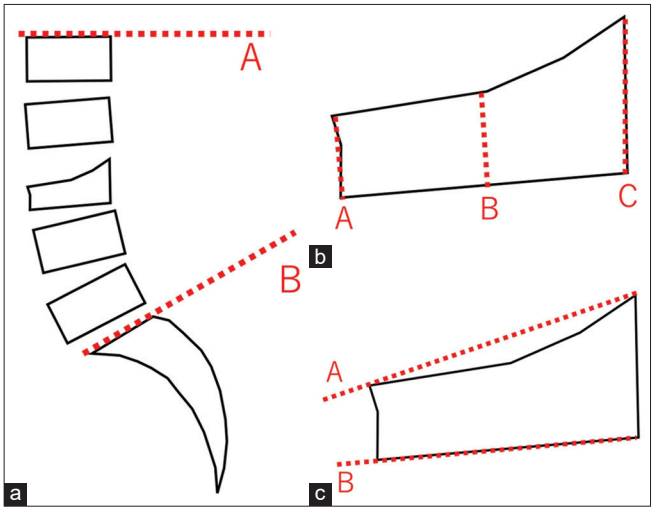

Figure 2: (a) Lumber lordosis (LL) was defined as the angle between the tangent lines to the inferior endplates of L1 (A) and superior endplates of S1 (B). (b) Fractured vertebral body height was defined as the mean value of the three measurements at the anterior (A), middle (B), and posterior vertebral body (C). (c) Focal angle is defined as the angle formed by the end plates of the vertebra above the fractured vertebra and below (A, B). Focal angles are presented with minus for kyphosis and plus for lordosis.

the treatment of lumbar canal stenosis (LCS) aggravated by osteoporotic vertebral fractures (OVFs).

MATERIALS AND METHODS

Eligible patients

Patients with progressive leg pain, numbness, or weakness after OVFs were included in this study. All patients had clear radiological findings of LCS along with neurological symptoms.

Operative technique

With the patient prone under general anesthesia, vertebral stabilization with BKP was performed before lumbar decompression. We, then, performed ULBD using the greenstick fracture method.[1] The paraspinal muscles were detached from the median structures, and unilateral laminectomy was performed under a microscope; the microscope was tilted medially for contralateral decompression [Figure 1].

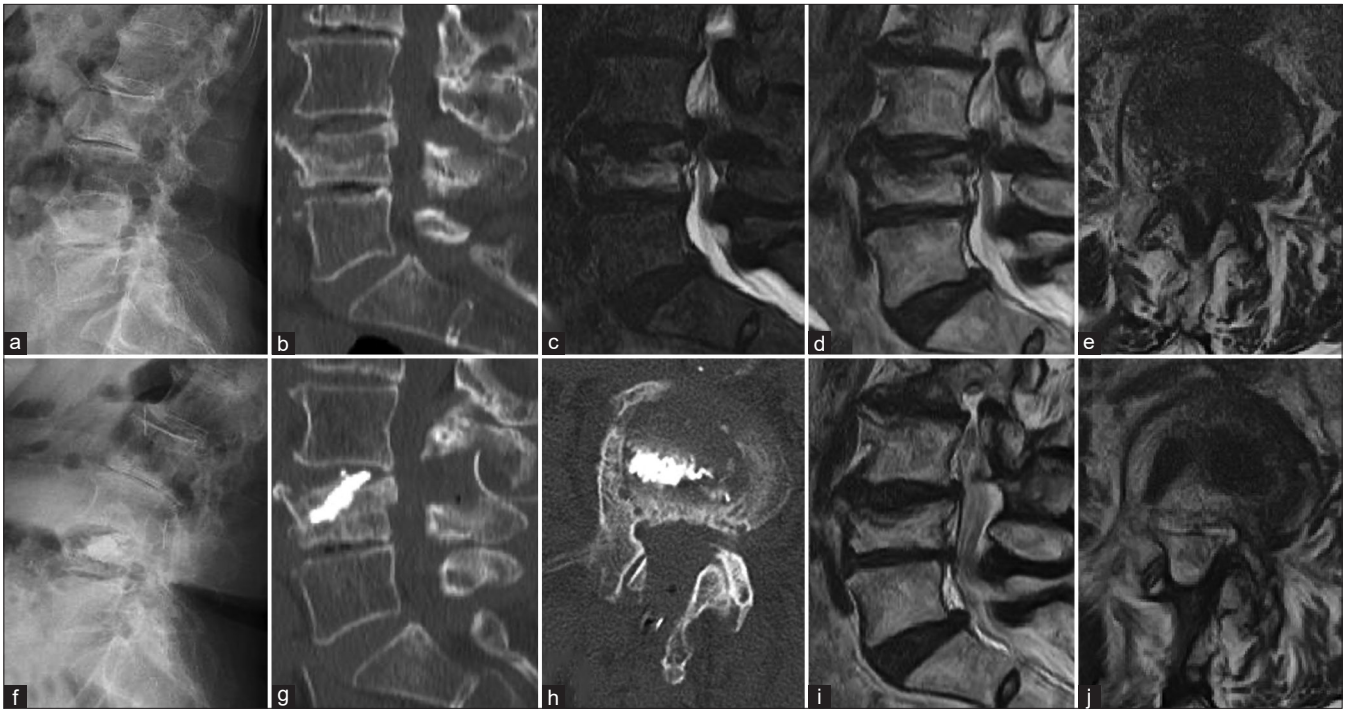

Figure 3: Radiological images before and after surgery in illustrative case. (Case 3) An 84-year-old female. Preoperative radiography shows an L4 compression fracture (a), and a sagittal computed tomography scan shows a cleft (b). Magnetic resonance imaging (MRI) with T2 STIR reveals a high signal at L4 (c). MRI T2WI showed severe lumbar canal stenosis at L3/4 (d and e). The patient underwent unilateral laminotomy and bilateral decompression combined with balloon kyphoplasty, which resulted in successful decompression and spinal stabilization (f-j).

Outcome measures

Clinical outcomes included the use of the numerical rating scale and Japanese Orthopaedic Association scores. Radiological outcomes included assessment of; fractured vertebral body height, lumbar lordosis (LL), and focal angle of the fractured vertebral body [Figure 2].

RESULTS

Surgical outcomes

The three patients undergoing these showed clear improvement in clinical and radiographic scores 6 months postoperatively [Table 1]. Two patients underwent one-level ULBD for LCS at the OVF level, while one patient had a three-level ULBD for L3–S1 LCS with L5 OVF. The loss of fractured vertebral body height was only 0.3–1.4 mm in all cases at 6 months postoperative. Two of the three cases showed restoration of LL and focal angle postoperatively. An illustrative case (Case 3) is presented in Figure 3.

DISCUSSION

Surgical treatment for LCS associated with OVFs consists of a variety of surgical techniques; laminectomy, percutaneous cement augmentation including BKP, or highly invasive procedures, such as multilevel posterior screw fixation with interbody fusion and vertebral body replacement. For OVFs, percutaneous cement augmentation should be considered first if neurological symptoms are caused by spinal instability without nerve compression on MRI.[2,3] In cases of lumbar foraminal stenosis combined with OVFs, percutaneous cement augmentation with endoscopic foraminotomy is reportedly effective.[4-6] Although the addition of lumbar decompression to percutaneous cement augmentation raises concerns, our technique of ULBD with the greenstick fracture method[1] did not adversely affect spinal alignment/stability.

CONCLUSION

ULBD combined with BKP may be a viable option for LCS aggravated by OVF.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Conflicts of interest

There are no conflicts of interest.

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